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ABSTRACT

This report presents the results of a videotape study of science teaching in Shenzhen, China. Shenzhen is one of China's first special economic zones adjacent to Hong Kong. Developed from a small fishing village in the late 1970s, Shenzhen experienced fast economic growth in the last two decades, which has steadily increased the diversity of the population in the educational system. To facilitate assessment of Shenzhen's science educational practices, videotaped instructions were analyzed along with information from teacher surveys and student assessments at urban, suburban, and rural schools. Results indicate that the college entrance examination expectations have a strong influence on science teaching. Regional differences in science education also hinge on contextual factors such as teaching conditions and lab equipment. Contains 14 references. (Author/WRM)

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A Videotape Study of Science Teaching in Shenzhen, China

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A Videotape Study of Science Teaching in Shenzhen, China

Shenzhen is one of China's first special economic zones adjacent to Hong Kong. Developed from a small fishing village in the late 1970s, Shenzhen experienced fast economic growth in the last two decades, which has steadily increased diversity of population in the education system. To facilitate assessment of Shenzhen's condition of science education, videotaped instructions were analyzed in this study along with information from teacher surveys and student assessments at urban, suburban, and rural schools. The results indicated a strong influence on science teaching from the college entrance examination. While assigning more homework has been a common strategy to cope with the high profile examination, regional differences in science education also hinge on other contextual factors, such as teaching conditions and lab equipment. Accordingly, an increase of educational investment seemed appropriate to improvement of the school facilities. Without considering the economic factor, researchers and policy analysts can be easily distracted by other historical events, such as Hong Kong's recent return to China, which have not shown much influence on Shenzhen's condition of science education under the existing "one nation, two system" framework.

A Videotape Study of Science Teaching in Shenzhen, China

Since Hong Kong's return to China in 1997, many researchers and policy analysts predicted that the mutual interactions between China and Hong Kong would eventually cause dramatic changes in both regions (Morris & Chan, 1997; Postiglione, 1998). Adjacent to Hong Kong is a city named Shenzhen, one of China's first special economic zones (SEZ). According to the Shenzhen Trade Development Bureau (1999),

> Special measures have been taken by the local education authority to facilitate the schooling of children of foreign investors and businessmen. So far, Asia-Pacific (Shenzhen) International School and some Hong Kong-funded kindergartens are already in operation. (p. 3)

The global market exchange has increased the population diversity in Shenzhen and presented a new challenge to its education system. While science curriculum in China has been primarily guided by a national syllabus, classroom instruction still depends on many factors, including different school facilities and community resources. The purpose of this study is to examine the relationship between science teaching and student learning among 10% of Shenzhen's secondary schools. The empirical findings may enrich information on the condition of Shenzhen's science education after implementation of China's "one nation, two systems" policy in 1997.

Background

The transition between national curriculum and student achievement hinges on effectiveness of the instruction process, which has not been thoroughly investigated until recent years (Peak, 1996). Researchers of the Third International Mathematics and Science Study (TIMSS) videotaped mathematics instruction in German, Japan, and the United States. However, China did not participate in the TIMSS project. Thus, contextual information related to the video recording should be clarified to facilitate understanding of the education background.

In the last two decades China developed the fastest growing economy in the world. Due to the regional connection with Hong Kong, Shenzhen has led the nation in the high technology

domain. While most export-oriented industries rely on expertise of a large group of advanced professionals, numerous manufacture sectors have also generated plenty job opportunities for the non-college bound labor force. The job creation has attracted various immigrants from Hong Kong and other parts of China. The most recent census data indicated that Shenzhen's population totaled 3.79 million, including 1.09 million permanent dwellers and 2.7 million nonpermanent ones. The responsibility of providing general education at the secondary level has been primarily assumed by around 60 secondary schools (Shenzhen Trade Development Bureau, 1999). Since majority of the high school graduates are likely to stay in this region, science instruction at the non-college bound level has played an important role in preparing the local labor force. Developed from a fishing village in the late 1970s, the Shenzhen community is split into urban, suburban, and rural areas. To reflect the condition of education in Shenzhen, the community coverage needs to be considered to balance the data representation in this investigation.

On the other hand, while the education system in Hong Kong has been moving toward accommodating the northern Chinese dialect, its school curriculum was originally designed by a Curriculum Development Committee, and remains different from the ones used in China (Schmidt, McKnight, Valverde, Houang, & Wiley, 1997). In recent years, the low cost of living in Shenzhen has lured many Hong Kong residents to purchase houses in Shenzhen and commute across the border. Yet, no substantial changes have been reported in Shenzhen's science education since the strengthening of bond with Hong Kong.

Instead, like in other regions of China, most schools in Shenzhen are guided to pursue a high rate of student college admission. Inevitably, science education has been part of the school program with its success represented by test scores. Although lab experiments are an essential component of the scientific training, it is difficult to use a paper-and-pencil test to assess the hands-on activities during the national college entrance examination. While similar textbooks have been adopted across China, schools of various communities may teach the contents with different teaching facilities. In general, due to the lack of education investment, some rural

schools do not have well-equipped science labs. Thus, the teaching facility can be an important indicator of education status for a specific school.

The aforementioned contextual information on secondary education can be triangulated with relevant evidence from the videotape study of science instruction. Wiersma (1995) noted,

> Within recent years, videotaping has increased as a data collection procedure. Videotaping has definite advantages when it applies, the overriding advantage being that the situation may be reviewed repeatedly for the purpose of obtaining more information. (P. 262)

Meanwhile, Glense (1999) added that "limitations of this type of data collection include the lack of contextual data beyond the recording" (p. 57). Hence, a combination of student assessments, teacher questionnaire, and videorecording can help triangulate instructional practice in Shenzhen schools.

Research Questions

While the bond between Shenzhen and Hong Kong has been strengthened since 1997, little information was reported on the condition of Shenzhen's science instruction following Hong Kong's return. Thus, research questions that have been investigated in this study were:

1. To what extent have the videotaped lectures complied to the national course syllabus in China?
2. To what extent did the students understand the videotaped instructions?
3. Are there any variations of the instructional outcome among different school communities?
4. To what extent has science education been influenced by the college entrance examination?

Methods

Because China has a national science curriculum, teachers can indicate the relative importance of the videotaped content according to the national syllabus. In addition, they are asked to judge importance of the instruction in their teaching plan. Consistency between the responses presents an indicator reflecting whether the videotaped lectures have followed the national course syllabus (Question 1). After the videorecording, students have been evaluated

on their understanding of each instruction (Question 2). To facilitate improvement of science teaching in different communities, 10% of Shenzhen secondary schools are randomly chosen from urban, suburban, and rural areas. The data have been collected in the 1998 Fall semester. One way ANOVA is employed to analyze the community differences in student performance (Question 3). The statistical analysis has been further triangulated with in-depth reviews of the video recording. In TIMSS, the review was conducted by a group of university faculty members, which has been criticized for lack of peer-review perspectives at the secondary level (Wang, 1998). To mend this void, videotapes from this investigation are reviewed by student-teachers and their peer supervisor from the University of Shenzhen, a primary institution in charge of teacher education in this region. Through a combination of statistical analyses and videotape studies, this investigation is focused on understanding the diversity of science instruction in different schools under the influence of the national curriculum.

Furthermore, students are asked in this study about their chance of college entrance. Because the admission is based on a paper and pencil test, a high rate of college admission can be achieved by assigning more student homework. Meanwhile, the higher admission rate can help recruit more funds to upgrade school facilities. Accordingly, empirical data have been collected on science homework and school facilities to assess their relationship with the opportunity of college admission in each school (Question 4).

Results

Science contents are specified in the national course syllabus under a unified semester schedule. To compare instructional practice among different schools, several science topics, such as force, gauge of force, harmonic oscillation, work and power, and switch function in a circuit, have been chosen for videotaping during the 1998 Fall semester. The content selection was based on the fact that they were ranked important in the national syllabus. Despite awareness of the content ranking, some teachers may have intentionally adjusted the status of importance in their instructional practice. In this study, a teacher survey indicated that half of

the instructors gave these contents a different rank based on their individual teaching plan (Figure 1). In reference to the situation in the U.S., although a set of national science standards has been developed by a professional organization (National Research Council, 1996), classroom instruction may reflect different interpretations of the standards by each science teacher. Thus, regardless of the cultural difference, teacher training seems important to the curriculum implementation in either nation.

Figure 1 inserted around here

Student performance was measured by the proportion of videotaped lectures that has been understood by a total of 299 students in six videotaped classes. The reliability index for this assessment was 0.71. The result of academic achievement showed 66% students with their performance at or above the 80% mastery level.

Figure 2 inserted around here

Furthermore, the regional differences were represented by different bar colors in Figure 2. The student data were subjected to an F-test in one-way ANOVA, and a significant difference was found in the student performance at α=.05 [$F(2, 296)=3.38$, $p=0.035$]. The Tukey's post hoc test further indicated that the significant difference was located between urban and rural regions.

The influence of college admission is directly related to the condition of science education. In this study, the chance of college admission has been estimated by each student, and the weekly homework hours and the capacity of lab facilities are treated as explanatory factors. A regression analysis has been conducted to examine whether these two factors are significant predictors of the student-estimated chance for college admission. The results indicate that both factors are significant at α=.05 with a coefficient of determination R^2=0.91 (Table 1).

Table 1 inserted around here

Discussions

Under guidance of the China national curriculum, the content of instruction has been specified for all schools. Because of the lack of teaching facilities in rural regions, teachers may tend to place more emphasis on paper and pencil exercises, which can be directly reflected by student achievement in regional or national tests. This speculation has been largely confirmed by videotape observations. For instance, a rural teacher has spent an entire class session on solving electric circuit problems through paper and pencil exercises. The videotape showed that she was a little impatient with student independent explorations beyond the routine training. In another example, an instructor delivered a lecture on the concept of power through five steps, review previous lessons, introduce new concepts, derive a formula, illustrate applications, and summary. The largest amount of time was devoted to explaining a solution of a complex problem involving multiple concepts. Later, a reviewer found a similar problem in a college entrance test. Thus, it was fair to assess that the instruction was quite relevant to student preparation for the paper and pencil examination.

It should be added that the test pressure was not confined in rural schools. Many teachers of other regions also developed their instructional plans with considerations of the test relevancy. Consequently, contents of experimentation were less pertinent to the test scores, and typically received a lower rank of importance (Figure 1). In this study, some teachers underestimated importance of topics like force and gauge of force partly because the related skills were not easy to measure in a paper and pencil test. Hence, the content sensitivity to student test performance was a contextual factor confounded in the instructional deviations from the national curriculum.

To achieve a high score in the test, it was important to ensure that students have mastered various routines of problem solving. In general, all reviewers agreed that the videotaped

instruction has an intensive coverage in each topic area. Perhaps because of the large amount of information, some teachers seemed reluctant to let students lead the learning process at a slower pace. The fast-paced instruction may have inadvertently caused intellectual deficiency in student understanding, and as a result, only 66% students had their performance rated at or above the 80% mastery level.

On the other hand, due to the diversity of school population in the Shenzhen community, equity is another issue of education deserving special attention. To date, researchers have found that urban Chinese students usually outperformed their western counterparts in academic achievement (Postlethwaite & Wiley, 1992; Stevenson & Stigler, 1992). But when the rural population was included in the comparison, the difference became statistically insignificant (Wang, 1996). The regional difference has been reconfirmed in this study. With better instructional facilities in urban and suburban schools, teachers can illustrate more science experiments. In this study, the videotapes showed that most students were deeply attracted by demonstrations of harmonic oscillation and electric transformer in two urban classrooms. In contrast, few rural schools have the experimental condition. The regional difference in lab facilities may have enlarged discrepancies in student achievement. The post hoc Tukey test confirmed the significant difference in student performance between urban and rural schools.

Furthermore, the school facility factor was examined in a regression analysis, and the result indicated significant influence of school facility on student estimated chance of college admission. In fact, 91% of the admission possibility was accounted for by the school facility factor and the weekly homework hours (Table 1). While more homework may help in a paper and pencil test, the facility upgrading eventually demands more government investment in education. Hao (1995) noted that only 1.04 percent of the education investment in the world was devoted to the Chinese education system which constituted 17.9 percent of the world's total population. The lack of education investment could be a fundamental issue behind the apparent inequity between urban and rural schools.

In summary, multiple sources of information were triangulated in this study to

disentangle the condition of science education in the Shenzhen Special Economic Zone. The results consistently supported an assertion of overwhelming examination pressure on science instruction. While more homework hours can be an effective practice to cope with the examination, the quality of education may still vary across schools, depending on contextual factors like teaching facilities and instructional emphases. Consequently, a direct concern of science instruction has been centered on the lack of support for further enhancing student skills in experimentation. Because the lab training was less sensitive to the existing measures of school success, some teachers may not stress the importance of experimentation, particularly in rural schools with insufficient lab equipment. Unlike Hong Kong which has a well-developed economy, China's lack of education investment was constrained by its limited financial resources, which resulted in inadequate teaching facilities and high presssure of college admission. Thus, without considering the economic factor, the territorial reunion between Hong Kong and China may not cause substantial changes on Shenzhen's condition of science education. Consequently, this investigation confirmed that students in Shenzhen were still enduring more hours of homework and having less training in experimental skills.

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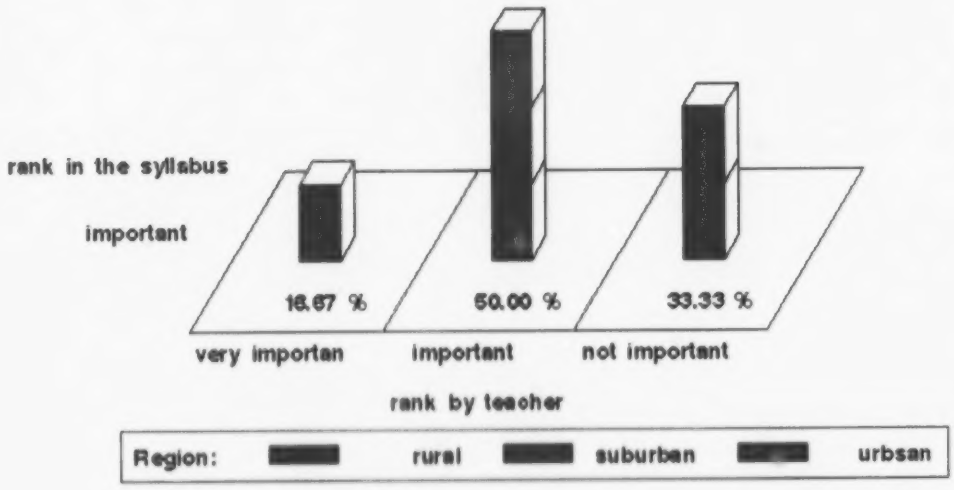
Figure 1: The Extent of Following the National Syllabus



Indicator: Consisteney on the Content Importance

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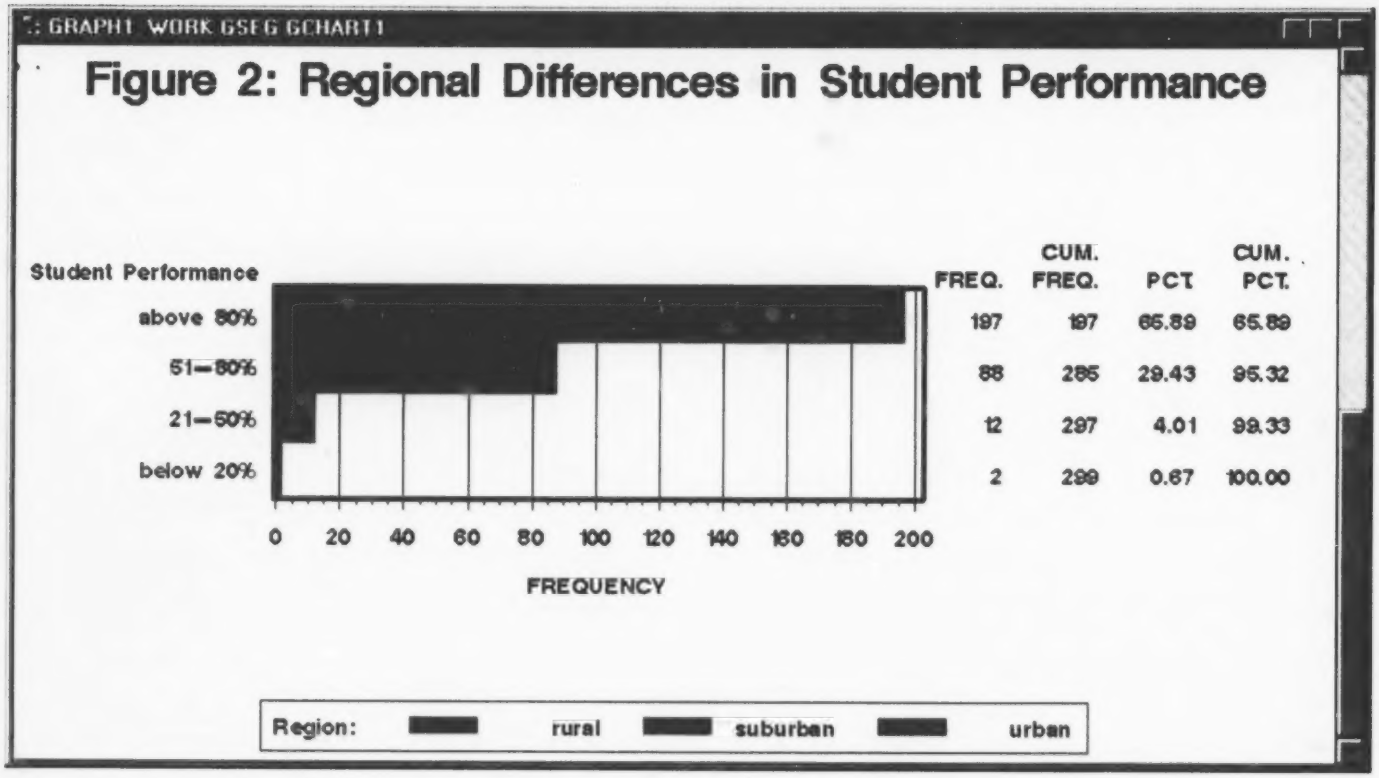

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Table 1

Regression of the rate of college admission on basis of factors of science instruction

Dependant Variable	factor	β	standard error	p for H_0: $\beta=0$
chance of admission	hours of homework	0.05	0.008	0.0001
	lab facilities	1.05	0.042	0.0001